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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/663,949

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Roswell J. Ruka

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Siemens Corporation
Intellectual Property Department
170 Wood Avenue South
Iselin, NJ 08830

EXAMINER

WALKER, KEITH D

ART UNIT

PAPER NUMBER

1745

DATE MAILED: 05/02/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/663,949

Applicant(s)

RUKA ET AL.

Examiner

Keith Walker

Art Unit

1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 February 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) 19-22 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Remarks

Claims 1-22 are pending in the application and claims 19-22 have been withdrawn from consideration for being drawn to a non-elected group. Claims 1-18 are examined on the merits as discussed below.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

1. Claims 1-4, 12 & 15-17 are rejected under 35 U.S.C. 102(b) as being anticipated by Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*) as evidenced by applicant's known background art.

Ramanarayanan teaches a solid oxide fuel cell with a lanthanum manganite cathode, a yttria-stabilized zirconia electrolyte and an anode of nickel and zirconia (Pg. 23). A bipolar plate is used to connect the cells together forming a fuel cell stack to generate power (Pg. 23-24). Plasma spraying is used for the deposition technique (Pg. 23). As admitted by applicant in the Background of Invention, plasma spraying gives a microstructure characterized by accumulated molten particle splats (Pg. 3 of instant application). The solid oxide fuel cell can be either a planer or tubular type (Fig. 3).

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2. Claims 1-5, 7-10 & 12-15 are rejected under 35 U.S.C. 102(b) as being anticipated by Clemmer et al. (*Influence of Nickel Distribution on the Processing and Properties of Porous Metal/Ceramic Composite Fuel Cells*).

Clemmer teaches a solid oxide fuel cell consisting of a nickel and zirconia anode, a yttria-stabilized zirconia (YSZ) electrolyte and a lanthanum manganite cathode (Pg. 319). The fuel electrode has a nickel composition of at least 60%, a graphite composition of at least 15%, and a zirconia composition of at least 15% (Table II & III).

3. Claims 1-8, 12-18 are rejected under 35 U.S.C. 102(b) as being anticipated by US Patent 5,589,285 (Cable) as evidenced by applicant's known background art.

Cable teaches a solid oxide fuel cell having a cathode of lanthanum manganite, an electrolyte with zirconia and 8 mole% of yttria, and an anode of nickel and zirconia (7:65-8:35, 10:18-20). The amount of nickel used is at least 60% and no more than 85% and the range for zirconia is more than 15% and less than 40% (16:1-20). The layers can be deposited by plasma deposition (8:30-35).

Regarding claims 16-18, a separator connects multiple fuel cells together to form a power generating system (14:44-68). A precursor layer, the interfacial layer, is formed on the fuel side. The layer is preferably 1-50 microns and made from a zirconia composition (8:25-10:18). The solid oxide fuel cell can be tubular in shape (1:55-57)

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 5, 6 & 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Clemmer et al. (*Influence of Nickel Distribution on the Processing and Properties of Porous Metal/Ceramic Composite Fuel Cells*).

The teachings of Clemmer as discussed above are incorporated herein.

Clemmer teaches the use of nickel and zirconia in the anode, but does not speak to the higher composition range of nickel and zirconia.

Clemmer also teaches that varying the amount of nickel in the electrode can change different characteristics of the electrode, such as increasing the nickel content increases the number of reaction sites and electrical conductivity but decreases the sintering shrinkage. It would have been obvious to one having ordinary skill at the time of the invention to vary the amount of nickel and zirconia to optimize electrode properties like electrical conductivity and reaction sites, since it is held that discovering an optimum value of a result effective variable involves only routine skill in the art (MPEP 2144).

Clemmer is silent to the use of interconnectors to link fuel cells together. It is well known in the art at the time of the invention to use bipolar plates or interconnectors to link multiple fuel cells together to gain the required power for a particular application. Since one fuel cell puts out only a minimal amount of current and voltage, multiple fuel cells are electrically connected by interconnectors in series and parallel to form fuel cell stacks and achieve the proper power for a given application.

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5. Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*) in view of Jensen (US Patent 5,035,962).

The teachings of Ramanarayanan as discussed above are incorporated herein. However, Barker fails to disclose the composition of the fuel electrode.

Jensen teaches a fuel electrode for an SOFC having a graded composition structure formed by successively depositing layers of nickel-yttria stabilized zirconia mixtures with different compositions (Col. 3, ll. 6-9). Table 1 (Col. 9) gives the compositions of the layers on a volume basis. In order to convert the volume percentages to weight percentages, the following formula was used:

$$\text{Weight}\%_j = \frac{\text{Vol}\%_j (\text{Vol}_j + \text{Vol}_k) \rho_j}{[\text{Vol}\%_j (\text{Vol}_j + \text{Vol}_k) \rho_j] + \text{Vol}\%_k (\text{Vol}_j + \text{Vol}_k) \rho_k} = \frac{\text{Vol}\%_j \rho_j}{[\text{Vol}\%_j \rho_j + \text{Vol}\%_k \rho_k]}$$

The densities used were obtained from www.matweb.com for yttria stabilized zirconia and nickel. The following table lists the weight percents corresponding the volume percents of Jensen's Table 1.

	Volume percent ZrO ₂	Weight percent ZrO ₂	Volume percent Ni	Weight percent Ni
Layer 1	70-90	63-87	10-30	13-37
Layer 2	40-60	33-53	40-60	47-67
Layer 3	10-30	7.6-24	70-90	76-92.3

As can be seen from the table Jensen teaches minimums of about 60% Ni and about 15% YSZ (claim 5) and about 70% Ni and about 20% YSZ (claim 6). Jensen also

teaches maximums of about 85% Ni and about 50% YSZ (claim 7) and about 80% Ni and about 30% YSZ. The compositions of the individual layers of the multiple layer graded structure approximate a layer in which the composition is continuously graded from being high in zirconia at the electrolyte interface to being high in nickel at the external surface of the anode and meets the simultaneous requirements of adhesion of the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the fuel electrode compositions as taught by Jensen in the fuel cell as taught by Ramanarayanan in order to meet the simultaneous requirements of adhesion of the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity.

6. Claims 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*) in view of Clemmer et al. (*Processing and Properties of Porous Ni-YSZ Metal/Ceramic Composites*), as evidenced by INCO, Ltd.

The teachings of Ramanarayanan as discussed above are incorporated herein. Ramanarayanan fails to teach that at least a portion of nickel in the fuel electrode is obtained from nickel graphite powder.

Clemmer teaches Ni/yttria-stabilized zirconia fuel cell anodes in which Ni-coated graphite particles (55% Ni content; obtained from INCO, Ltd.: Pg. 233) were used as a starting material. Generally, the anodes created from the Ni-coated graphite particles had a lower coefficient of thermal expansion and higher electrical conductivity for a

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given Ni loading compared to the anodes made of separate Ni and graphite particles.

The hybrid structures had intermediate values of coefficient of thermal expansion and electrical conductivity (Abstract).

Nickel coated graphite particles available from INCO contain either 60 or 75% (www.incosp.com).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Ni-coated graphite particles, such as those available from INCO, as a starting material for Ni/yttria-stabilized zirconia fuel cell anodes as taught by Clemmer in the fuel cell as taught by Ramanarayanan in order to achieve lower coefficient of thermal expansion and higher electrical conductivity for a given Ni loading.

7. Claims 13 & 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*).

The teachings of Ramanarayanan as discussed above are incorporated herein.

Ramanarayanan teaches that the yttrium oxide dopant in the Ni/YSZ anode serves to stabilize the high temperature cubic phase in zirconia and also generates oxygen vacancies through a defect reaction to create more of the ion conducting species. Nickel may be used as the anode, but the thermal expansion of nickel does not match with that of the electrolyte, YSZ, and nickel may sinter at fuel cell operating temperatures. By forming a skeleton of YSZ around the nickel to form a cermet, the electrode thermal expansion coefficient is brought closer to that of the electrolyte and thus provides for better adhesion. (Pg. 22-24). It has been held that discovering an

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optimum value of a result effective variable involves only routine skill in the art (MPEP 2144).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the percentage of yttria in the Ni/YSZ anode in order to minimize thermal stress by matching the anode and electrolyte thermal expansion coefficients and to provide better adhesion between the anode and electrolyte.

8. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*) in view of Cable et al. (5,589,285).

The teachings of Ramanarayanan as discussed above are incorporated herein; however, the reference fails to teach the precursor layer between electrolyte and fuel electrode containing zirconia.

Cable teaches an SOFC with a cathode containing lanthanum manganate (Col. 7, l 66 – Col. 8, l 2), an electrolyte of yttria-stabilized zirconia (Col. 8, ll. 12-14), and an anode containing a nickel powder mixed with zirconia (Col. 10, ll. 18-20). Between the electrolyte and anode, an interfacial layer (applicant's precursor layer) containing sulfur tolerant material is disposed (Col. 3, ll. 1-3); the interfacial layer may contain Y-doped ZrO_2 (Col. 10, ll. 1-4; applicant's zirconia). The thickness of the interfacial layer is generally 1-100 μm , preferably less than 50 μm (Col. 8, ll. 35-37). The interlayer serves to improve electrical contact between the electrolyte and anode and provides an environment in which the species can interact or react because the interlayer keeps

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sulfur from the fuel from poisoning the anode, particularly Ni/YSZ cermet anodes (Col. 8, ll. 19-34; Col. 6, ll. 55-63; Col. 18, ll. 23-29).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the Y-doped zirconia interlayer as taught by Cable between the anode and the electrolyte of the fuel cell as taught by Ramanarayanan in order to improve electrical contact and provide an environment in which the species can interact or react.

Response to Arguments

Applicant's arguments filed have been fully considered but they are not persuasive. Applicant argues the prior art references presented above do not teach "a microstructure characterized by accumulated molten particle splats." As noted by applicant in the background art, the molten particle splats are an inherent characteristic of plasma spraying which is taught by the prior art, as noted above.

Concerning applicant's note to the date of the Ramanarayanan reference and the affidavit filed by the applicant, the prior art is applied as a 35 USC 102(b) reference and therefore is a statutory bar and is not overcome by such an affidavit.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

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A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Keith Walker whose telephone number is 571-272-3458. The examiner can normally be reached on Mon. - Fri. 8am - 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KW



PATRICK JOSEPH RYAN
SUPERVISORY PATENT EXAMINER